Fachverband Extraterrestrische Physik (EP)

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Übersicht der Hauptvorträge und Fachsitzungen

(HS 19)

Hauptvorträge

EP 1.1	Mo	16:30–17:00	HS 19	**The Sun in high resolution** — •Lucia Kleint
EP 2.1	Di	11:00–12:00	HS 19	**ROSAT - A key Project in Astronomy and Extraterrestrial Physics** — •Joachim Trümper
EP 2.2	Di	12:00–12:30	HS 19	**Magnetic Reconnection in Space, Laboratory and Astrophysical Plasmass** — •Jörg Büchner
EP 2.3	Di	12:30–13:00	HS 19	**The diversity of exoplanet interiors** — •Caroline Dorn
EP 5.1	Do	11:00–11:30	HS 19	**Machine Learning and Atmospheric-Ionospheric Coupling** — •Jerry Czarnecki
EP 5.2	Do	11:30–12:00	HS 19	**New Results in Modelling the Space Debris Environment** — •Carsten Wiedemann, Andre Horstmann, Sebastian Hesselbach, Vitali Braun, Holger Krag, Sven Flegel, Michael Oswald
EP 6.1	Do	12:00–12:30	HS 19	**Interactions of multiple stellar winds inside stellar clusters** — •Alexander Noack, Klaus Scherer, Jens Kleimann, Horst Fichtner, Kerstin Weis
EP 8.1	Do	14:15–14:45	HS 19	**Mercury, the Innermost Planet: State of Knowledge and Prospects for the BepiColombo Mission** — •Hauke Hussmann
EP 8.4	Do	15:15–15:45	HS 19	**The Impact of Space Weather on the Atmosphere of Proxima Centauri b** — •Vanessa Schmidt, Miriam Sinnhuber
EP 10.5	Fr	12:00–12:30	HS 19	**Synthetic radiation simulations as a path to study the relativistic Kelvin-Helmholtz instability in interstellar jets** — •Richard Pausch, Michael Bussmann, Axel Huebl, Ulrich Schramm, Klaus Steiniger, René Widera, Alexander Debus

Hauptvorträge des fachübergreifenden Symposiums SYMD

Das vollständige Programm dieses Symposiums ist unter SYMD aufgeführt.

SYMD 1.1	Mo	14:00–14:30	Plenarsaal	**Analysis of historical solar Ca II K and sunspot data for irradiance studies** — •Theodosios Chatzistergos, Natalie A Krivova, Sami K Solanki, Ilaria Ermolli, Ilya Usoskin, Gennady Kovaltsov
SYMD 1.2	Mo	14:30–15:00	Plenarsaal	**MUSiC: A Model Unspecific Search for New Physics** — •Deborah Duchardt, Thomas Hebbeker
SYMD 1.3	Mo	15:00–15:30	Plenarsaal	**Search for solar chameleons with an InGrid based X-ray detector at the CAST experiment** — •Christoph Krieger
SYMD 1.4	Mo	15:30–16:00	Plenarsaal	**Positron Annihilation Spectroscopy throughout the Milky Way** — •Thomas Siegert

Hauptvorträge des fachübergreifenden Symposiums SYSA

Das vollständige Programm dieses Symposiums ist unter SYSA aufgeführt.

SYSA 1.1	Di	14:00–14:30	Plenarsaal	**Remote sensing of planetary atmospheres: questions and (some) answers.** — •Martine De Maziere, Sieglinde Callewaert, Bart Dils, Bavo Langerock, Charles Robert, Mahesh K. Sha, Sophie Vandenbussche, Corinne Vigouroux, Minqiang Zhou
SYSA 1.2	Di	14:30–15:00	Plenarsaal	**24 years of atmospheric trace gas observations from spectrally resolving UV/vis satellite observations: optimisation of the spatio-temporal resolution and coverage** — •Thomas Wagner
SYSA 1.3	Di	15:00–15:30	Plenarsaal	**Infrared Remote Sensing of the Atmosphere of Mars** — •Armin Kleinböhl
SYSA 1.4	Di	15:30–16:00	Plenarsaal	**Investigating planetary atmospheres in our own Solar System and beyond: Advances and Perspectives** — •Miriam Rengel

Hauptvorträge des fachübergreifenden Symposiums SYPA

Das vollständige Programm dieses Symposiums ist unter SYPA aufgeführt.

SYPA 1.1	Mi	14:00–14:30	Plenarsaal	**Laser-driven ion acceleration in plasmas** — •Jörg Schreiber
SYPA 1.2	Mi	14:30–15:00	Plenarsaal	**Laser-driven electron acceleration in plasmas** — •Jeroen van Tilborg
SYPA 1.3	Mi	15:00–15:30	Plenarsaal	**Beam-driven electron acceleration in plasmas** — •Richard D'Arcy
SYPA 1.4	Mi	15:30–16:00	Plenarsaal	**Solar energetic electron events: Trying to understand the role of the shock** — •Nina Dresing, Max Bruedern, Raúl Gómez-Herrero, Bernd Heber, Andreas Klassen, Manuela Temmer, Solveig Theesen, Astrid Veronig
SYPA 2.1	Mi	16:30–17:00	Plenarsaal	**Plasma Wakefield Acceleration: Instabilities and Stabilization** — •Alexander Pukhov
SYPA 2.2	Mi	17:00–17:30	Plenarsaal	**LUX - A Laser-Plasma Driven Undulator Beamline** — •Andreas R. Maier
SYPA 2.3	Mi	17:30–18:00	Plenarsaal	**Magnetic reconnection as a particle accelerator** — •Michael Hesse
SYPA 2.4	Mi	18:00–18:30	Plenarsaal	**Experimental demonstration of proton bunch self-modulation and of electron acceleration in a 10m-long plasma** — •Patric Muggli

Hauptvorträge des fachübergreifenden Symposiums SYPS

Das vollständige Programm dieses Symposiums ist unter SYPS aufgeführt.

SYPS 1.1	Mi	15:00–15:40	HS 5	**Black-hole superradiance: Probing ultralight bosons with compact objects and gravitational waves** — •Paolo Pani
SYPS 1.2	Mi	15:40–16:10	HS 5	**Modelling and analyzing a binary neutron-star merger: Interpreting a multi-messenger picture** — •Tim Dietrich
SYPS 1.3	Mi	16:10–16:40	HS 5	**What can neutron-star mergers reveal about the equation of state of dense matter?** — •Ingo Tews

Fachsitzungen

EP 1.1–1.8	Mo	16:30–18:45	HS 19	**Sun and Heliosphere I**
EP 2.1–2.3	Di	11:00–13:00	HS 19	**Arne Richter Lecture and invited talks**
EP 3.1–3.9	Di	16:30–18:45	HS 22	**Planetary Atmospheres (joint session EP/UP)**
EP 4.1–4.6	Mi	11:30–13:00	HS 19	**Sun and Heliosphere II**
EP 5.1–5.2	Do	11:00–12:00	HS 19	**Near Earth Space**
EP 6.1–6.3	Do	12:00–13:00	HS 19	**Astrophysics I: Astrospheres**
EP 7	Do	13:00–14:00	HS 19	**Mitgliederversammlung der AEF und DPG-EP**
EP 8.1–8.5	Do	14:15–16:00	HS 19	**Planets and Exoplanets**
EP 9.1–9.25	Do	16:30–19:00	Foyer Nordbau	**Poster**
EP 10.1–10.5	Fr	11:00–12:30	HS 19	**Astrophysics II: Galaxies and Cosmology**
EP 11.1–11.4	Fr	12:30–13:30	HS 19	**Astrophysics III: Stellar Astrophysics**

Mitgliederversammlung AEF und Fachverband Extraterrestrische Physik

Donnerstag, 21.03.2019 13:00 HS 19

- Begrüßung
- Feststellung der Beschlussfähigkeit
- Kenntnisnahme des Protokolls der Mitgliederversammlung 2018
- Bericht des Vorstandes
- Bericht des Schatzmeisters (AEF)
- Entlastung des Vorstandes (AEF)
- Höhepunkte und Veranstaltungen 2018, 2019
- Bericht aus DPG und der DPG-Sektion Materie und Kosmos (SMuK).
- Bericht aus den Kommissionen
- Internationale Weltraumwetterinitiative ISWI
- Satzungsänderungen der AEF
- Wahlen
- Abstimmung über Tagungsorte 2022 und 2023 (AEF und DPG-EP).
- Webseite und Mitgliederverwaltung (AEF)
- Sonstiges

EP 1: Sun and Heliosphere I

Zeit: Montag 16:30–18:45 Raum: HS 19

Hauptvortrag EP 1.1 Mo 16:30 HS 19

The Sun in high resolution — •Lucia Kleint — Leibniz-Institut für Sonnenphysik (KIS), Freiburg, Germany

GREGOR is Europe's largest solar telescope and allows us to study the solar atmosphere at scales as small as 50 km. Some of the important open questions in solar physics only become accessible by studying the Sun at such scales: What is the fine structure of sunspots? How does the quiet Sun magnetic field evolve? How is energy dissipated during solar flares? Because dynamic events on the Sun can take place within seconds and because polarimetric observations are essential to derive the magnetic field, even solar observations often reach a photon-starved regime, which can only be tackled with larger and larger telescopes. I will review recent advances in high-resolution observations and take flare physics as an example to address open questions in solar physics.

EP 1.2 Mo 17:00 HS 19

Nonlinear magnetohydrostatic modeling of an active region based on SUNRISE/IMaX vector magnetogram — •Xiaoshuai Zhu and Thomas Wiegelmann — Max Planck Institute for Solar System Research, Goettingen, Germany

Nonlinear magnetohydrostatic (NLMHS) model is the better approximation of the physical state in the lower solar atmosphere than nonlinear force-free (NLFF) model. It is not just in magnetic field, it is also in terms of plasma distribution. In the test case, the NLMHS model has been able to meaningfully recover the plasma density and pressure. Here we present a first application of our new code to an active region (AR 11768) that was observed by IMaX polarimeter during the second flight of the balloon-borne SUNRISE solar observatory in 2013. Using the high spatial resolution IMaX vector magnetogram which is embedded in the HMI data to cover the total active region, we are able to model the non-force-free layer in the lower atmosphere. The strongly localized plasma distribution, electric current and Lorentz force in the result show that the NLMHS model has the important advantage of extrapolating the solar lower atmosphere than linear MHS and NLFF models.

EP 1.3 Mo 17:15 HS 19

Constraining energy release and transport processes in solar flares with X-ray and bolometric observations — •Alexander Warmuth and Gottfried Mann — Leibniz-Institut für Astrophysik Potsdam (AIP), An der Sternwarte 16, 14482 Potsdam

Energy release and transport processes in solar flares are constrained by means of a comprehensive characterization of the physical parameters of both the thermal plasma and the accelerated nonthermal electrons, using X-ray observations from RHESSI and GOES. This is complemented by bolometric radiated energies as measured by SORCE and SOHO/VIRGO. We find evidence for two plasma components: a cooler component (10-20 MK) evaporated from the chromosphere, and an additional hotter component (>20 MK) which is more consistent with direct in-situ heating of coronal plasma. The potentially very significant role of conductive energy losses is investigated. Finally, the relative contribution of electron acceleration versus direct heating (i.e., the acceleration efficiency) is studied as a function of flare importance.

EP 1.4 Mo 17:30 HS 19

Kelvin–Helmholtz instability in rotating solar jets observed by *Hinode* and AIA/*SDO* — •Ivan Zhelyazkov — Faculty of Physics, Sofia University, 1164 Sofia, Bulgaria

Over the past two decades, several space missions have enabled our understanding of Kelvin–Helmholtz instability in the Sun's atmosphere. Key results obtained by *Hinode* and Atmospheric Imaging Assembly on board the *Solar Dynamics Observatory* allowed us to get useful data concerning the physical parameters of various solar jets. The rotating solar jets are among the most spectacular events in our Sun. They support the propagation of a number of magnetohydrodynamic (MHD) modes which, under some conditions, can become unstable and the developing instability is of the KH kind. The modeling of tornado-like phenomena in solar chromosphere and corona as moving weakly twisted and spinning cylindrical flux tubes shows that the KHI rises at the excitation of high-mode MHD waves within a wavenumber range/window whose width depends on the MHD mode number m, the plasma density contrast between the rotating jet and its environment, as well as on the twists of the internal magnetic field and jet's velocity. We have studied KHI instability in a twisted solar polar coronal hole jet, in a twisted rotating jet from a filament eruption, and in a rotating macrospicule. It has been established that good agreement between the theoretically calculated KHI developing times of a few minutes at wavelengths comparable to the half-widths of the jets, and those growth times detected from observations can be achieved at the excitation of high ($9 < m < 52$) MHD modes only.

EP 1.5 Mo 17:45 HS 19

Multi-Spacecraft Analyse von Forbush-Decreases — •Jan Ole Fehrs, Patrick Kühl und Bernd Heber — Christian-Albrechts-Universität zu Kiel

Die galaktische kosmische Strahlung, die ihren Ursprung außerhalb des Sonnensystems hat, wird durch die solare Aktivität auf verschiedenen Zeitskalen moduliert. Die Variation mit dem Sonnenzyklus nennt man die solare Modulation. Auf kürzeren Zeitskalen von Stunden bis zu mehreren Tagen nimmt der Teilchenfluss aufgrund interplanetarer Störungen ab. Sogenannte transiente und wiederholende Forbush-Decreases treten im Zusammenhang mit Koronalen Massenauswürfen und korotierenden Wechselwirkungsregionen auf. Durch die Messungen an mehreren Punkten in der Heliosphäre ist es möglich, die räumliche Entwicklung von Massenauswürfen zu studieren. In dieser Arbeit werden dafür Messungen des Elektron Proton Helium Instrument (EPHIN) an Bord der Raumsonden Chandra und SOHO genutzt.

EP 1.6 Mo 18:00 HS 19

Shock accelerated electron beams in the solar corona — •Gottfried Mann — Leibniz-Institut fuer Astrophysik Potsdam, Potsdam, Deutschland

In the solar corona shock waves can be generated either by the blast wave due to a flare or driven ahead of a coronal mass ejection (CME). Such shocks are observed as solar type II bursts in the solar radio radiation indicating the generation of energetic electrons at these shock. The radio emission at shocks are regarded to be plasma emission, i.e. the energetic electrons excite Langmuir waves due to beam-plasma interaction. These Langmuir waves convert into escaping radio waves as a result of nonlinear plasma processes This mechanism requires that the velocity of energetic electrons must necessarily exceed 4 times the thermal electron speed. Assuming shock drift acceleration as the mechanism for producing energetic electrons at shocks a beam-like electron velocity distribution function is established in the upstream region of the shock. Such electron beams are really observed in the solar radio radiation in terms of herringbones as fine structures in type II radio bursts. The observational data can be explained in the best way, if the shock propagates nearly perpendicular to the ambient magnetic field. That is the case at the flanks of shocks driven by a CME.

EP 1.7 Mo 18:15 HS 19

Velocity Dispersion Analysis of Corrected SEPT Electron Measurements — •Alexander Kollhoff[1], Nina Dresing[1], Andreas Klassen[1], Raúl Gómez-Herrero[2], and Bernd Heber[1] — [1]Institut für Experimentelle und Angewandte Physik, University of Kiel — [2]Dpto. de Física y Matemáticas, Universidad de Alcalá

Solar energetic particle events with an impulsive intensity time profile are dominated by electrons with energies up to a few hundred keV. The velocity dispersion of these electrons, observed at 1 AU, can provide information about how they are injected and transported through the inner heliosphere. Measurements of the Solar Electron and Proton Telescope (SEPT) aboard the Solar TErrestrial RElations Observatory (STEREO) are utilised in the solar heliospheric community to investigate electron events. Due to the instrumental setup, energetic electrons can scatter out of the solid state detector, depositing less than their total energy. Therefore, each SEPT electron channel has a response to electrons with energies above its nominal energy range. This effect of contamination becomes especially significant during the rise time of SEP events, when the energy spectrum is flattened as a result of the velocity dispersion. Computation using a GEANT4 simulation of the SEPT instrument resulted in new response functions for electrons. These response functions are used to correct the contamination of highly energetic electrons to lower electron channels. The corrected intensities are used to analyse the velocity dispersion of several SEP events. These analyses suggest a longer particle path and an earlier injection time compared to uncorrected measurements.

EP 1.8 Mo 18:30 HS 19

Elektronenbeschleunigung an CIRs. Eine statistische Analyse der Elektronenkanäle des SEPT an Bord von STEREO — •Henrik Dröge, Alexander Kollhoff, Bernd Heber, Patrick Kühl und Nina Dresing — Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel, Leibnizstraße 11, 24118 Kiel, Germany

Interplanetare Schocks sind bekannt dafür, energiereiche Ionen zu beschleunigen. Inwiefern Elektronen und bis zu welchen Energien sie beschleunigt werden ist Gegenstand der Forschung. Schocks können zum Beispiel im Rahmen von Coratating Interaction Regions (CIRs) entstehen. Die dabei beschleunigten Teilchen können mit Hilfe des Solar Electron and Proton Telescope (SEPT) an Bord der Raumsonden STEREO-A bzw. STEREO-B gemessen werden. Die Messmethode von SEPT beruht auf dem Prinzip der Magnet/Folien Technik, die zur Trennung von Elektronen und Ionen benutzt wird. In den Arbeiten von Wraase et al. (2018) wird anhand eines Einzelereignis gezeigt, dass Ionen in den Elektronenkanälen detektiert werden. In dieser Arbeit wird diese Methode auf eine große Anzahl von CIRs angewandt und statistisch ausgewertet. In ungefähr 76% konnte gezeigt werde, dass die gemessenen Elektronenzählraten durch eine Ionenkontamination der Elektronenkanäle erklärt werden kann.

EP 2: Arne Richter Lecture and invited talks

Zeit: Dienstag 11:00–13:00 Raum: HS 19

Hauptvortrag EP 2.1 Di 11:00 HS 19

ROSAT - A key Project in Astronomy and Extraterrestrial Physics — •Joachim Trümper — MPE Garching, Giessenbachstr.1, D-85740 Garching

After introductory remarks about the early years of the AEP/AEF I will describe the history of x-ray astronomy in Germany which culminated in the 1990's with the ROSAT observations, delivering a wealth of discoveries in the X-ray sky.

Preparations for this mission started in 1972 at the Astronomical Institute of the University Tübingen and were intensified in 1974/75 at MPE Garching. A proposal to the "Program of big projects in fundamental science paved the way for the development of the satellite and instruments by a cooperation of DLR, MPE, Carl Zeiss, MBB, Dornier and GSOC. In 1982 the UK and NASA joined the project.

After the launch in June 1990 ROSAT conducted an year all sky survey for half a year - the first one with a powerful imaging telescope - followed by 8 years of pointed observations open to a guest observer program of a wide scientific community. The ROSAT science covers many topics from solar system objects out to quasars at cosmological distances, and from the tiny neutron stars to the clusters of galaxies as the largest objects in the universe.

Hauptvortrag EP 2.2 Di 12:00 HS 19

Magnetic Reconnection in Space, Laboratory and Astrophysical Plasmass — •Jörg Büchner — Center for Astronomy and Astrophysics, Technical University Berlin — Max-Planck-Institute for Solar System Research Göttingen

Reconnection is a phenomenon of magnetic energy release processes, often explosive, in space - , laboratory - and astrophysical plasmas. Conjectured in the 1940ties for the Sun, with first theoretical descriptions in the 1950ties, it has been found to take place starting from small, plasma scales to the large scales typical for astrophysical phenomena. We discuss the current state of understanding reconnection including latest results about its relationship with plasma turbulence and structure formation processes.

Hauptvortrag EP 2.3 Di 12:30 HS 19

The diversity of exoplanet interiors — •Caroline Dorn — University of Zurich

Over the past decades, planet characterization has become a main focus in exoplanetary science. The increasing number of newly discovered extrasolar planets reveal a remarkable diversity in planet sizes and mean densities. Among the most frequently occurring planets are super-Earths and mini-Neptunes, which lack a counterpart in the Solar System. The distribution of interior types among super-Earths and mini-Neptunes is largely unknown.

The challenge in determining planetary interior stems from the fact that data are limited and data uncertainties are large. In a good scenario, both planet mass and radius can be determined. However, very different interiors can be modelled from identical mass and radius. In order to draw meaningful conclusions about a planetary interior, it is therefore mandatory to rigorously quantify interior parameter degeneracy, to carefully select prior knowledge on possible interiors, and to search for additional constraints that can be made available. I will review the state-of-the-art interior characterization and highlight main achievements in finding exotic and less exotic worlds.

It is our understanding of planet formation and evolution that will greatly benefit from more detailed characterized distributions of interior types.

EP 3: Planetary Atmospheres (joint session EP/UP)

Zeit: Dienstag 16:30–18:45 Raum: HS 22

EP 3.1 Di 16:30 HS 22

Lidar-Messungen von extremen Schwerewellen an der Südspitze Südamerikas — •Natalie Kaifler, Bernd Kaifler, Andreas Dörnbrack und Markus Rapp — Deutsches Zentrum für Luft- und Raumfahrt, Institut für Physik der Atmosphäre, Oberpfaffenhofen, Deutschland

Mit dem CORAL-Rayleigh-Lidar befindet sich seit November 2017 ein vollautomatisches Lidar-System für Temperaturmessungen bis in 90 km Höhe in Rio Grande, Argentinien, an der Südspitze Südamerikas. Aufgrund der starken Winde und der Topographie treten in dieser Region die weltweit stärksten atmosphärischen Schwerewellen auf. Wir zeigen die Aktivität von Schwerewellen im Jahresverlauf, auch im Vergleich zu entsprechenden Messungen während der DEEPWAVE-Kampagne 2014 in Neuseeland. Anhand eines mehrere Tage anhaltenden, extremen Schwerewellen-Ereignisses im Juni 2018 mit Spitzenamplituden von 80 K wird die Ausbreitung der Wellen in der Atmosphäre und deren Einfluß auf die Hintergrundströmung anhand von Lidar-Messungen und ECMWF-Analysen erläutert. Die Messungen in Rio Grande dienen auch der Vorbereitung und Begleitung der SouthTRAC-Kampagne mit dem Forschungsflugzeug HALO, die im September 2019 in der Region stattfinden wird. Während SouthTRAC werden die Rolle von Schwerewellen und stratosphärischer Zirkulation für das Klima der Südhemisphäre untersucht.

EP 3.2 Di 16:45 HS 22

Validation of the Multiple Airglow Chemistry model applied on the basis of data sets from various sources — •Olexandr Lednyts'kyy[1], Miriam Sinnhuber[2], and Christian von Savigny[1] — [1]University of Greifswald, Greifswald, Germany — [2]Karlsruhe Institute of Technology, Karlsruhe, Germany

The Multiple Airglow Chemistry (MAC) model was proposed to couple electronically excited states of molecular (O_2, four states) and atomic (O, two states) oxygen with each other as well as with the O_2 and O ground states to represent the photochemistry in the upper Mesosphere and Lower Thermosphere region. Rate values of processes coupling seven O_2 and three O states considered in the extended MAC model were tuned on the basis of the in-situ measurements from the Energy Transfer in the Oxygen Nightglow campaign. Calculations with the MAC model are verified and validated on the basis of the in-situ measurements from the 2nd WAve propagation and DISsipation in the middle atmosphere campaign and the WAVes in airglow structures Experiment 2004 campaign. The MAC calculations are analyzed in various cases, in which some of these in-situ data sets are replaced with collocated remote measurements or data sets simulated with the NRLMSISE-00 (Naval Research Laboratory Mass Spectrometer Incoherent Scatter Extended, 2000) model. The level of self-consistency of the MAC input and output data sets varies from one case to another.

EP 3.3 Di 17:00 HS 22

Long-term evolution of MLT-temperatures above Europe as observed by the GRIPS spectrometers within the Network for the Detection of Mesospheric Change (NDMC) — •Carsten Schmidt[1], Lisa Küchelbacher[1], Sabine Wüst[1], and Michael Bittner[1,2] — [1]Deutsches Zentrum für Luft- und Raumfahrt, Oberpfaffenhofen — [2]Universität Augsburg

The German Aerospace Center (DLR) operates more than a dozen identical, so-called ground-based infrared p-branch spectrometers (GRIPS) in eight European countries to study excited hydroxyl-molecules in the upper mesosphere / lower thermosphere (MLT region). They contribute high quality observations to the Network for the Detection of Mesospheric Change (NDMC). Observations started at the Environmental Research Station Schneefernerhaus (UFS), Germany (47.42 N, 10.98 E) in October 2008.

Clearly, a long-term oscillation with a period of several years (ca. 8 years) modulates the OH temperatures. Maximum temperatures are reached during winters 2013 to 2015. This behavior implies a correlation with variations of solar activity (F10.7cm). However, the winter oscillation is not only more pronounced but it also precedes the variation in summer with a lead of 0.5 to 1.5 years. These variations can, at least in part, explain several remarkable seasonal patterns observed at all mid-latitude sites, e.g. between 2016 and 2018.

We attribute the different behavior to changes of northern middle atmospheric dynamics, having a larger impact on winter temperatures. Observations at the southern sites in Italy and Israel support this view.

EP 3.4 Di 17:15 HS 22

Solar heating rates derived from SCIAMACHY observations of the O_2 dayglow — •Miriam Sinnhuber[1], Stefan Bender[2], Thomas Reddmann[1], and Amirmahdi Zarboo[1] — [1]Karlsruhe Institute of Technology, Karlsruhe, Germany — [2]University of Trondheim, Trondheim, Norway

Solar heating by ozone absorption in the UV spectral range is an important contributor to radiative heating of the terrestrial stratosphere and mesosphere. At altitudes above about 60 km, the efficiency of the heating is reduced as part of the absorbed energy is transferred to excited species – $O_2(^1\Sigma)$, $O_2(^1\Delta)$ – and lost by emission.

We use observations of the $O_2(^1\Sigma)$ and $O_2(^1\Delta)$ dayglow in the mesosphere and lower thermosphere observed by SCIAMACHY on ENVISAT from 2008-2012 to derive ozone densities and the efficiency of the ozone solar heating. The heating efficiency decreases from 1 around 60 km to less than 0.6 at the mesopause depending on latitude and time of year. Resulting ozone heating rates vary from more than 10 K/day in the lower mesosphere to less than 1 K/day around 80 km, with a secondary maximum of up to 5 K/day around 90 km in the region of the second ozone maximum.

EP 3.5 Di 17:30 HS 22

The relativistic electron radiation belt response to CME- and CIR-driven geomagnetic storms — •Frederic Effenberger, Yuri Shprits, Nikita Aseev, Juan Sebastian Cervantes Villa, and Angelica Maria Castillo Tibocha — Helmholtz Zentrum Potsdam, Deutsches Geoforschungs Zentrum GFZ

The Earth's magnetosphere responds differently to storms driven by coronal mass ejections (CME) and co-rotating interaction regions (CIR). To understand the effects of geomagnetic activity on the inner and outer magnetosphere, CME- and CIR-driven storms should be considered separately. In this work, we investigate the impact of both types of storms on the radiation belt environment during the Van Allen Probe era, using the Versatile Electron Radiation Belt (VERB) code. We use the Kp index as a measure of geomagnetic activity to parameterize wave models, diffusion coefficients, and the plasmapause location. The electron population is considered to originate from the plasma sheet, and we set up the outer boundary conditions at geostationary orbit using GOES data. We model storm individually and with long-term simulations, and compare the simulation results with Van Allen Probes measurements to validate the model performance. We use data assimilation methods to assist with initial and boundary conditions and the validation and we utilize different performance metrics. The work shows, how well we understand the response of the belts to CME and CIR drivers and helps to identify the applicability of present wave models to CME- or CIR-driven storms.

EP 3.6 Di 17:45 HS 22

Middle atmosphere ionization from particle precipitation as observed by the SSUSI satellite instruments — •Stefan Bender and Patrick Espy — Norwegian University of Science and Technology, Trondheim, Norway

Solar, auroral, and radiation belt electrons enter the atmosphere at polar regions leading to ionization and affecting its chemistry. Climate models usually parameterize this ionization and the related changes in chemistry based on satellite particle measurements. Precise measurements of the particle and energy influx into the upper atmosphere are difficult because they vary substantially in location and time. Widely used particle data are derived from the POES and GOES satellite measurements which provide electron and proton spectra.

We present electron energy and flux measurements from the Special Sensor Ultraviolet Spectrographic Imagers (SSUSI) satellite instruments. This formation of satellites observes the auroral zone in the UV from which electron energies and fluxes are inferred. We use these observed electron energies and fluxes to calculate ionization rates and electron densities in the mesosphere. We also present an initial comparison of these rates to other models and compare the electron densities to those measured by the EISCAT radar.

EP 3.7 Di 18:00 HS 22

Spectropolarimetric Simulations of Earthshine — •Mihail Manev[1], Claudia Emde[1], Michael Sterzik[2], and Stefano Bagnulo[3] — [1]Meteorological Institute, Ludwig-Maximilians-University, Theresienstr. 37, D-80333 Munich, Germany — [2]European Southern Observatory, Karl-Schwarzschild-Str. 2, D-85748 Garching, Germany — [3]Armagh Observatory and Planetarium, College Hill, Armagh BT61 9DG, UK

Understanding exoplanet atmospheres and ultimately the remote detection of signatures of life from other worlds belong to the most important goals of modern astrophysics. Earth serves as a benchmark object to infer biosignatures of life as we know it today. One way to study Earth as an exoplanet is to observe Earthshine: sun-light scattered by Earth and back-reflected from the lunar surface to Earth.

Here we interpret spectropolarimertic observations of Earthshine carried out at the VLT (Sterzik et al., Spectral and Temporal Variability of Earth Observed in Polarization, accepted at A&A on 28-Nov-2018, https://arxiv.org/abs/1811.12079) utilizing the Monte Carlo radiative transfer model MYSTIC and employing meteorological and satellite data as an input (Emde et al., Influence of aerosols, clouds, and sunglint on polarization spectra of Earthshine, A&A, Vol. 605, A2, 2017). The results reveal the contributions of the major components of the Earth system to the spectropolarimetric signal: water and land surfaces, vegetation, atmospheric gases, water and ice clouds.

We think that similar simulations will become an important tool for the interpretation of observations of exo-Earth type planets.

EP 3.8 Di 18:15 HS 22

Atmospheric Characterization via Broadband Color Filters on the PLAnetary Transits and Oscillations of stars Mission — •John Lee Grenfell[1], Mareike Godolt[2], Juan Cabrera[1], Ludmila Carone[3], Antonio Garcia Muñoz[2], Daniel Kitzmann[4], and Heike Rauer[1,2,5] — [1]Department of Extrasolar Planets and Atmospheres (EPA), German Aerospace Centre (DLR), Berlin, Germany — [2]Centre for Astronomy und Astrophysics (ZAA), Berlin Institute of Technology (TUB), Germany — [3]Max-Planck-Institute for Astronomy (MPIA), Heidelberg, Germany — [4]Centre for Space and Habitability (CSH), Bern, Switzerland — [5]Institute for Geological Sciences, Free University Berlin (FUB), Germany

We assess broadband color filters for the two fast cameras on the PLAnetary Transits and Oscillations of stars space mission with respect to the characterization of exoplanetary atmospheric composition, haze and geometric albedo. We focus on Ultra Hot Jupiters and Hot Jupiters placed 25pc and 100pc away from the Earth and low mass low density planets placed 10pc and 25pc away. Our analysis takes as input literature values for the difference in transit depth between the broadband lower (500-675nm) wavelength interval (hereafter referred to as blue) and the upper (675-1125nm) broadband wavelength interval (hereafter referred to as red) for transmission, reflection and occultation spectroscopy. Planets orbiting main sequence central stars with stellar classes F, G, K and M are investigated. We calculate the signal-to-noise ratio with respect to photon and instrument noise for detecting the difference in the blue and red spectral intervals.

EP 3.9 Di 18:30 HS 22

Modeling the Formation of super-Earth Atmospheres — Nicolas Cimerman[1], •Rolf Kuiper[1], and Chris Ormel[2] — [1]University of Tübingen — [2]University of Amsterdam

In the core accretion paradigm of planet formation, gas giants form a massive atmosphere via run-away gas accretion once their progenitors exceed a threshold mass: the critical core mass. On the one hand, the majority of observed exo-planets never crossed this line. On the other hand, these exo-planets have accreted substantial amounts of gas from the circumstellar disk during their embedded formation epoch.

We investigate the hydrodynamical and thermodynamical properties of proto-planetary atmospheres by direct numerical modeling of their formation phase. Our studies cover one-dimensional (1D) spherically symmetric, two-dimensional (2D) axially symmetric, and three-dimensional (3D) simulations with and without radiation transport.

In terms of hydrodynamic evolution, no clear boundary demarcates bound atmospheric gas from disk material in a 3D scenario in contrast to 1D and 2D computations. The atmospheres denote open systems where gas enters and leaves the Bondi sphere in both directions. In terms of thermodynamics, we compare the gravitational contraction of the forming atmospheres with its radiative cooling and advection of thermal energy, as well as the interplay of these processes. The coaction of radiative cooling of atmospheric gas and advection of atmospheric-disk gas prevents the proto-planets to undergo run-away gas accretion. Hence, this scenario provides a natural explanation for the preponderance of super-Earth like planets.

EP 4: Sun and Heliosphere II

Zeit: Mittwoch 11:30–13:00 Raum: HS 19

EP 4.1 Mi 11:30 HS 19

Realistic solar modulation of cosmic rays in a semi-analytical framework — •Marco Kuhlen and Philipp Mertsch — Institute for Theoretical Particle Physics and Cosmology (TTK), RWTH Aachen University, Germany

When galactic cosmic rays enter the heliosphere they encounter the solar wind with its frozen-in magnetic field, which can modulate the cosmic ray flux in the heliosphere up to energies as high as 50 GeV. This problem is oftentimes treated in the simple force field approximation that characterises the modulation effects in a single parameter. However, this simplicity is at the cost of reducing the dimensionality of the problem and ignoring important transport processes like drifts in the inhomogeneous large-scale field. Predictions from force-field models are also in tension with recent time-dependent data from experiments like PAMELA and AMS-02. In this work, we present a new and straightforward extension to the force field model that takes into account charge sign dependent modulation due to drifts in the heliospheric magnetic field. We compare our semi-analytical results both to time-dependent data and to a numerical solution of the full transport equation and find good agreement.

EP 4.2 Mi 11:45 HS 19

Qualitative test particle simulations of pitch angle modifications due to Alfvénic waves — •Duncan Keilbach, Lars Berger, Verena Heidrich-Meisner, and Robert F. Wimmer-Schweingruber — Institut für Experimentelle und Angewandte Physik, Christian Albrechts Universität zu Kiel

We simulate the interaction of singly charged oxygen ions (treated as test particles) with Alfvénic cyclotron waves. In contrast to our preceding work, the pitch angle distribution of the test particles is not becoming isotropized when interacting with an intermittent mono-frequent wave field. Rather, the pitch angle distribution is governed by stationary patterns after an initial broadening. And that broadening has shown to be mainly a function of wave frequency and amplitude, as well as the phase difference between particle gyration and wave oscillation. A systematic study of these parameters may reveal insights about wave particle interactions on microscopic scales. E.g. resonances have shown to be less sharp than expected. Particles reacting strongest to the wave are found in a broad frequency area around first order resonance. The area's width is a function of the wave amplitude. Our approach is readily expandable to include a multitude of different modifications to the simulated magnetic field like the interaction with multiple wave frequencies or a change of the background magnetic field's strength and direction. It is also possible to include the interaction with multiple waves of e.g. varying frequencies and amplitudes.

EP 4.3 Mi 12:00 HS 19

Kinetic Solar Wind Models — •Sophie Aerdker — Ruhr-Universität Bochum

The processes of proton heating in the solar wind have not been determined yet but one possibility is the interaction with resonant ion-cyclotron waves. A kinetic model based on the Boltzmann-Vlasov equation is presented which takes the wave-particle interaction into account, so that the temporal evolution of the proton velocity distribution function can be calculated. The wave-particle interaction leads to diffusion in the velocity space, forming resonant shells whose shapes depend on the dispersion relation. Thus, the resulting velocity distribution function is expected to be deformed compared to the initial Maxwellian condition. The resonance condition as well as the dispersion relation of the ion-cyclotron waves are simplified in order to reduce the computational effort. The advantages and limitations of this new approach are tested and the results are compared to existing models.

EP 4.4 Mi 12:15 HS 19

On the entropy of plasmas described with regularized κ-distributions — •Horst Fichtner[1], Klaus Scherer[1], Marian Lazar[1,2], Hans Fahr[3], and Zoltan Vörös[4] — [1]Institut für Theoretische Physik IV, Ruhr-Universität Bochum, Germany — [2]Centre for Mathematical Plasma Astrophysics, Katholieke Universiteit Leuven, Belgium — [3]Argelander Institut für Astronomie, Universität Bonn, Germany — [4]Space Research Institute, Austrian Academy of Sciences, Graz, Austria

Recently, the debate about the physics foundations of so-called (standard) κ-distributions (SKDs), which describe plasma constituents with power-law velocity distributions, has intensified. Amongst other critical features, the extensitivity of entropy has been questioned in the context of a theoretical foundation for the SKDs. In classical thermodynamics the entropy is an extensive quantity, i.e. the sum of the entropies of two subsystems in equilibrium with each other is equal to the entropy of the full system consisting of the two subsystems. We demonstrate here, by employing the recently introduced *regularized κ-distributions* (RKDs) that entropy can be defined as an extensive quantity even for such power-law-like distributions that truncate exponentially.

EP 4.5 Mi 12:30 HS 19

Linear Dispersion Theory with Regularised κ-Distributions: Overcoming Defiencies of Standard κ-Distributions — •Edin Husidic — Institut für Theoretische Physik, Lehrstuhl IV: Plasma-Astroteilchenphysik, Ruhr-Universität Bochum, D-44780 Bochum, Germany

The velocity distributions of the plasma populations in the solar wind deviate from Maxwellian distributions, showing enhanced suprathermal tails, which can be well described with the standard κ-distribution function (SKD). However, due to diverging velocity moments, the SKD is only defined for values $\kappa > 3/2$. To remove this unphysical characteristic and the limitations of the SKD, the regularised κ-distribution function (RKD), for which all velocity moments converge and which can reproduce as limiting cases both the bi-Maxwellian and the SKD, has been introduced recently (Scherer et al. 2018). Using the grid-based kinetic dispersion relation solver LEOPARD (Astfalk and Jenko 2017), for the first time the dispersion curves and the growth and damping rates of different plasma instabilities are computed for plasma populations characterised by RKDs. The results are compared to those obtained earlier for SKDs. The implications of the study and newly opened perspectives by use of the RKD are discussed.

EP 4.6 Mi 12:45 HS 19

Thermal Atmospheric Neutron Observation System Junior Flight Results — •Lisa Romaneehsen, Friederike Schattke, Marc Hansen, Patrick Pohland, Jonas Zumkeller, Bernd Heber, and Robert Wimmer-Schweingruber — Christian-Albrechts- Universität zu Kiel, Institut für Experimentelle und Angewandte Physik, Abteilung Extraterrestrische Physik, Deutschland

The Earth is continuously exposed to high energy charged particles from galactic cosmic rays. Due to galactic cosmic rays interacting with atmospheric particles, secondary neutrons are generated. Those are moderated to thermal energies below 0.025 eV through elastic scattering. The main objective of the Thermal Atmospheric Neutron Observation System (TANOS) is to measure the flux of thermal neutrons in the stratosphere. In order to measure these low energy neutrons we make use of the conversion electrons resulting through thermal neutron capture in Gadolinium. Gadolinium is particularly suitable for the experiment due to its high cross section of 49000 barn. To validate this method we built, tested, and launched a simplified version of the TANOS detector on a weather balloon in September 2018. The balloon reached a height of 39 km and crossed the Pfotzer maximum at 20 km. However, the analysis of the neutron channel can be contaminated by x-rays. In this talk we will present and discuss the results of the flight.

EP 5: Near Earth Space

Zeit: Donnerstag 11:00–12:00 Raum: HS 19

Hauptvortrag EP 5.1 Do 11:00 HS 19
Machine Learning and Atmospheric-Ionospheric Coupling — •Jerry Czarnecki — Leibniz-Institut für Atmosphärenphysik

It is known that the atmospheric tides have significant effects on the spatial and temporal structure of the Earth's ionosphere and vice versa. This feedback mechanism, which is itself a manifestation of the actions and interactions of the E- and F-region dynamos, is not fully understood but is an important factor that influences the Mesospheric-Lower Thermospheric (MLT) tidal winds at mid and high latitudes. Understanding and quantifying these influences is important for improving current physical models of the E- and F-region dynamos and the associated feedback mechanisms on the tides. The focus of this talk will be the potential application of Machine Learning techniques to the study and quantification of the MLT wind-ionospheric interaction and the challenge of data preparation. A discussion of some challenges encountered during an ongoing investigation into this atmospheric-ionospheric interaction will be discussed.

Hauptvortrag EP 5.2 Do 11:30 HS 19
New Results in Modelling the Space Debris Environment — •Carsten Wiedemann[1], Andre Horstmann[1], Sebastian Hesselbach[1], Vitali Braun[2], Holger Krag[2], Sven Flegel[3], and Michael Oswald[4] — [1]Institut für Raumfahrtsysteme, TU Braunschweig, Hermann-Blenk-Str. 23, 38108 Braunschweig — [2]Space Debris Office, ESA/ESOC, Robert-Bosch-Str. 5, 64293 Darmstadt — [3]Space Environment Research Centre (SERC) Ltd. — [4]Airbus Defence & Space GmbH

At the Institute for Space Systems of the TU Braunschweig, the latest version of the European model for the description of the space debris environment MASTER is currently being developed. MASTER stands for "Meteoroid and Space Debris Terrestrial Environment Reference". The development is carried out on behalf of the European Space Agency ESA. The model considers numerous different sources of space debris. As part of the update, the contributions of the individual sources have been scientifically revised. This revision includes to a lesser extent the introduction of new sources. Far more important, however, is the addition of further events to already considered sources that were not known in the past. It is also necessary to add events that have occurred since 2009, when the last version of the MASTER model was published. The revision includes the complete creation of the historical particle population on Earth orbits. The particle flux, to which satellites are exposed today, will be shown here for various selected mission examples.

EP 6: Astrophysics I: Astrospheres

Zeit: Donnerstag 12:00–13:00 Raum: HS 19

Hauptvortrag EP 6.1 Do 12:00 HS 19
Interactions of multiple stellar winds inside stellar clusters — •Alexander Noack[1], Klaus Scherer[1], Jens Kleimann[1], Horst Fichtner[1], and Kerstin Weis[2] — [1]Institut für Theoretische Physik IV, Ruhr-Universität Bochum, 44780 Bochum, Germany — [2]Astronomisches Institut, Ruhr-Universität Bochum, 44780 Bochum, Germany

This talk deals with the interaction of stellar winds inside stellar clusters. We have investigated the principal flow structure of combined multiple stellar winds, including stagnation points and boundary regions of asymmetrical cluster configurations using hydrodynamical methods. We have, first, applied the theory of complex potentials to analyze planar cases analytically. Second, this model was expanded to fully three-dimensional, asymmetric configurations with the aid of numerics.

We found (i) that one can distinguish regions in the large-scale cluster wind that are determined by the individual stellar winds, (ii) that there are comparatively narrow outflow channels, and (iii) that the large-scale cluster wind asymptotically approaches spherical symmetry at large distances. Consequently, one must conclude that the combined flow inside a stellar cluster resulting from the interaction of multiple stellar winds is highly structured.

More information can be found in the related paper: K. Scherer, A. Noack, J. Kleimann, H. Fichtner and K. Weis, 2018, A&A, 616, A115.

EP 6.2 Do 12:30 HS 19
Skymaps of observables of three-dimensional MHD astrosphere models — •Lennart Robin Baalmann — Ruhr-Universität Bochum

Sky maps of three-dimensional MHD single-fluid models of astrospheres are created by projecting the modeled cells on the surface of a sphere. By choosing different physical parameters to be integrated, sky maps of different observables can be created, e.g. the Hα flux, the bremsstrahlung flux, the cyclotron flux, the Faraday rotation measure or the column density. The method is applied to the astrospheres of different stars, including λ Cephei and the Sun (heliosphere). Compared to current observational limits, only the fluxes of the λ Cephei astrosphere may be observed.

EP 6.3 Do 12:45 HS 19
MHD-shock structures of astrospheres — •Klaus Scherer[1], Lennart Baalmann[1], Horst Fichtner[1], Jens Kleimann[1], Dominik Bomans[2], Kerstin Weis[2], and Stefan Ferreira[3] — [1]Institut für theoretische Physik IV, Ruhr-Universität Bochum, 44780 Bochum, Germany — [2]Astronomisches Institut, Ruhr-Universität Bochum, 44780 Bochum, Germany — [3]Centre for Space Research, North-West University, 2520 Potchefstroom, South Africa

The interpretation of recent observations of bow shocks around O stars and the creation of corresponding models require a detailed understanding of the associated (magneto-)hydrodynamic structures, which will be discussed here. We discuss in detail the magnetohydrodynamic structures associated with stellar bow shocks, which are of high relevance for further studies of turbulence and cosmic-ray modulation. We describe in detail the fast- and slow-magnetosonic regions using the corresponding Mach numbers. We show that in O star astrospheres, distinct regions exist in which the fast, slow, Alfvénic, and sonic Mach numbers become lower than one, implying sub-slow magnetosonic, as well as sub-fast and sub-sonic flows.

EP 7: Mitgliederversammlung der AEF und DPG-EP

Zeit: Donnerstag 13:00–14:00 Raum: HS 19

Tagesordnung ist im Vorspann

EP 8: Planets and Exoplanets

Zeit: Donnerstag 14:15–16:00 Raum: HS 19

Hauptvortrag EP 8.1 Do 14:15 HS 19

Mercury, the Innermost Planet: State of Knowledge and Prospects for the BepiColombo Mission — •Hauke Hussmann — DLR Institute of Planetary Research, Berlin, Germany

After its successful launch on Oct 20 2018, ESA's BepiColombo mission is on its way to Mercury the innermost planet of the solar system. Mercury is an intriguing planetary object with respect to its dynamical state and evolution. The planet is differentiated and contains a large iron core overlain by a relatively thin silicate mantle and crust. Mercury is locked in a unique 3:2 spin-orbit coupling (three rotations around its axis equal two revolutions about the sun), and its intrinsic magnetic dipole field tells us that at least part of Mercury's iron core is liquid. From libration measurements (small periodic changes in the planet's spin-rate) it has been concluded that Mercury's outer core is liquid, decoupling the silicate mantle from the deep interior. Phases of global contraction and phases of volcanic activity constrain the thermal evolution of the planet. Here the current knowledge on the evolution of Mercury, focusing on its dynamical, rotational and orbital state is summarized. Prospects for investigations with BepiColombo and its various instruments will be discussed.

EP 8.2 Do 14:45 HS 19

Analysis of JUNO-observed Pitch Angle Spectra of heavy Ions in Jupiter's Middle Magnetosphere — •Michael Schöffel[1], Joachim Saur[1], Barry Mauk[2], and George Clark[2] — [1]Institut für Geophysik und Meteorologie, Universität zu Köln, Köln, Deutschland — [2]Applied Physics Laboratory, The Johns Hopkins University , Laurel, Maryland, USA

Here we analyze He, S, O and H ions measured by the JEDI instrument in the energy range from (60 to 1350) keV, (486 to 10.000) keV, (370 to 10.000) keV and (30 to 2600) keV, respectively, at rotational equator crossing distances to Jupiter between 30 - 100 R_J. We study how the energy and pitch angle spectra of these ions change inside and outside the current sheet and look at their radial and latitudinal dependency. A prime objective is to investigate the energization mechanism of the heavy ions observed in the middle magnetosphere that heats up ions to much higher temperatures than expected for an adiabatic process. We further use the JUNO data to estimate the thickness of Jupiter's current sheet.

EP 8.3 Do 15:00 HS 19

Mapping the Brightness of Ganymede's UV Aurora using HST STIS Observations — •Alexander Marzok[1], Joachim Saur[1], Denis Grodent[2], and Lorenz Roth[3] — [1]University of Cologne, Institute for Geophysics and Meteorology — [2]University of Liège, Institute for Astrophysics and Geophysics — [3]KTH Institute of Technology, Department of Space and Plasma Physics

Ganymede is the only known moon in the solar system with an intrinsic magnetic field and two auroral ovals around its magnetic north and south poles. In this work we analyze Hubble Space Telescope (HST) observations of Ganymede at OI 1356 Å to study the structure of its auroral ovals. Our aim is to combine HST observations from various epochs to generate a brightness map of Ganymede's two auroral ovals. Charged particles from Jupiter's magnetosphere can not excite the brightest emissions of 300 R only from the reported electron temperatures, but need to be accelerated due to magnetic reconnection happening between the magnetic field lines of Jupiter and Ganymede. The sub-alfvénic speed of the charged particles makes the Ganymede system different compared to the planets in the solar wind because no bow shock is formed, resulting in a non-turbulent environment that is ideal to study the phenomenon. Our created map is intended to serve as a diagnostic tool helping to investigate the process of magnetic reconnection responsible for the emissions and structure of the aurora.

Hauptvortrag EP 8.4 Do 15:15 HS 19

The Impact of Space Weather on the Atmosphere of Proxima Centauri b — •Vanessa Schmidt and Miriam Sinnhuber — Karlsruhe Institute of Technology, Institute of Meteorology and Climate Research, Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen, Germany

Proxima Centauri is an M-dwarf star and the Sun's nearest stellar neighbor. It is orbited by a planet within its habitable zone at a distance of approximately 0.05 AU. Due to the planet's close proximity to its host star and the comparatively high stellar activity of Proxima Centauri, it is subjected to stellar energetic particles fluxes many times higher than those received on Earth - with potentially considerable implications for the planet's atmosphere.

In our work, we study the interaction of ionizing radiation with the atmosphere of Proxima Centauri b in order to quantify the impact of stellar radiation on molecules influenced by biogenic processes such as ozone, nitrous oxide, and methane. Using a 1-dimensional stacked box column model of the neutral and ionized atmosphere, we can obtain the production rates of several important neutral species, which allows us to determine the long time effect of stellar activity on the atmospheric concentrations of bioindicators.

This research is a joint operation between the University of Kiel, the Technical University Berlin and the Karlsruhe Institute of Technology and funded by the DFG.

EP 8.5 Do 15:45 HS 19

Time-variable Star-Planet Interaction in the TRAPPIST-1 system — •Christian Fischer and Joachim Saur — Institut für Geophysik und Meteorologie, Universität zu Köln, Köln, Deutschland

Star-planet interaction (SPI) describes the electromagnetic coupling of an exoplanet to its host star. Due to the bright intrinsic emissions of stars SPI is difficult to observe. Accordingly there is no entirely convincing observational evidence for SPI so far. Therefore we present different mechanisms that cause time-variability in SPI and allow to identify related signals as of planetary origin. We chose the TRAPPIST-1 system as an example to apply our findings and show that there are hints of SPI in existing observations of the system.

EP 9: Poster

Zeit: Donnerstag 16:30–19:00 Raum: Foyer Nordbau

EP 9.1 Do 16:30 Foyer Nordbau

The Elementary Particle of Dark Matter Forming the Gosset Lattice — •Ole Rademacker[1] and Hans-Otto Carmesin[1,2,3] — [1]Gymnasium Athenaeum, Harsefelder Straße 40, 21680 Stade — [2]Universität Bremen, Fachb. 1, Pf. 330440, 28334 Bremen — [3]Studienseminar Stade, Bahnhofstraße 5, 21682 Stade

An equivalence principle is elaborated and founded. With it a third development of H.-O. Carmesins theory of quantum gravity is presented. The theory combines quantum physics with general relativity and is based on three numerical inputs only: the constants G, c and h (Carmesin, H.-O. (2018): A Model for the Dynamics of Space - Expedition to the Early Universe. PhyDid B, p. 1-9. Carmesin, H.-O. (May 2018): Entstehung dunkler Materie durch Gravitation, Model for the Dynamics of Space and the Emergence of Dark Matter. Berlin:

Verlag Dr. Köster. Carmesin, H.-O. (July 2018): Entstehung dunkler Energie durch Quantengravitation, Universal Model for the Dynamics of Space, Dark Matter and Dark Energy. Carmesin, H.-O. (November 2018): Entstehung der Raumzeit durch Quantengravitation, Theory for the Emergence of Space, Dark Matter, Dark Energy and Space-Time. Berlin: Verlag Dr. Köster.). The most stable local solution of that theory is elaborated and identified with the elementary particle of dark matter. It forms the Gosset lattice or E8 lattice at the ground state. Corresponding phonons can in principle be observed with gravitational waves. The total amount of mass formed by the novel elementary particle is in accurate accordance with the observed total mass of dark matter in the universe, whereby the difference is 0.23 % only.

EP 9.2 Do 16:30 Foyer Nordbau

A Numerical Study of the Solution of the Horizon Problem and of the Flatness Problem — •Lennert Sprenger[1] and Hans-Otto Carmesin[1,2,3] — [1]Gymnasium Athenaeum, Harsefelder Straße 40, 21680 Stade — [2]Universität Bremen, Fachb. 1, Pf. 330440, 28334 Bremen — [3]Studienseminar Stade, Bahnhofstraße 5, 21682 Stade

An equivalence principle has been developed and used in a research club. From that principle Hans-Otto Carmesins theory of quantum gravity has been derived. With it fundamental problems of physics have been solved and an accurate accordance with observations has been achieved. Thereby all results have been obtained by using only three numerical inputs: the natural constants G, c and h. In addition a novel minimization principle has been developed. It establishes a tool for the analysis of emerging structures at the ground state. In particular the era of cosmic inflation has been explained and excellent quantitative accordance with observations of the CMB is achieved, whereby the deviation is below 3 %. Thereby the flatness problem, the horizon problem and the problem of energy conservation have been solved (see for instance Carmesin, H.-O. (2018): A Model for the Dynamics of Space - Expedition to the Early Universe. PhyDid B, p. 1-9. Sprenger, L. and Carmesin, H.-O. (2018): A Computer Simulation of Cosmic Inflation. PhyDid B, p. 1-4. Carmesin, H.-O. (May 2018): Entstehung dunkler Materie durch Gravitation, Model for the Dynamics of Space and the Emergence of Dark Matter. Berlin: Verlag Dr. Köster.). Here we present a numerical study that shows the solutions of the horizon problem and of the flatness problem in more detail.

EP 9.3 Do 16:30 Foyer Nordbau

Numerical Investigation of the Emergence of Dark Energy and the Time Evolution of the Hubble Constant — •Paul Brüning[1] and Hans-Otto Carmesin[1,2,3] — [1]Gymnasium Athenaeum, Harsefelder Straße 40, 21680 Stade — [2]Universität Bremen, Fachb. 1, Pf. 330440, 28334 Bremen — [3]Studienseminar Stade, Bahnhofstraße 5, 21682 Stade

An equivalence principle has been developed and used in a research club. From that principle H.-O. Carmesins theory of quantum gravity has been derived. With it fundamental problems of physics have been solved and an accurate accordance with observations has been achieved based on the fundamental natural constants G, c and h only. In particular the emergence of dark energy has been explained by zero - point oscillations of the gravitational field and excellent quantitative accordance with observations of the CMB has been achieved, whereby the deviation is below 0.073 %. The zero - point oscillations are polychromatic. Therefrom the different measured Hubble constants have been explained with an accuracy of 1 % (see for instance Carmesin, H.-O. (2018): A Model for the Dynamics of Space - Expedition to the Early Universe. PhyDid B, p. 1-9. Carmesin, H.-O. (July 2018): Entstehung dunkler Energie durch Quantengravitation, Universal Model for the Dynamics of Space, Dark Matter and Dark Energy. Berlin: Verlag Dr. Köster.). Here we present a study of the zero - point oscillations that achieves a high numerical detail. In particular we calculate the time evolution of the measurable Hubble constant.

EP 9.4 Do 16:30 Foyer Nordbau

Die Gedanken sind frei. Philosophie des Universums — •Helmut Hille — Fritz-Haber-Straße 34, 74081 Heilbronn

Von Anaximander aus Milet (ca. 611 - 545) wurde als einer der ältesten Sätze der antiken Philosophie überliefert: "Der Ursprung der seienden Dinge ist das Unbegrenzte. Denn aus diesem entstehe alles und zu diesem vergehe alles. Weshalb auch unbeschränkt viele Welten produziert werden.* Ohne heutige Kenntnisse in Physik und Kosmologie konnte Anaximander rein durch Vernunftüberlegungen diese Aussage treffen, die m.E. immer Bestand haben wird, solange wir der Vernunft und nicht dem Wunschdenken oder dem Zeitgeist folgen. Dazu gilt es, als Erstes zwischen Universum und Kosmos zu unterscheiden. Ein Kosmos ist ein geordnetes Ganzes, das aus einem gemeinsamen Ereignis hervorgegangen ist, das wir Big Bang oder auf Deutsch *Urknall* nennen. Das Universum ist das räumlich und zeitlich Unbegrenzte, in dem es unzählige Kosmen oder andere Konfigurationen gibt, wodurch bereits die Frage nach der Herkunft des von uns bewohnten Kosmos beantwortet ist. Ein Kosmos geht aus einer zusammenströmenden Materie oder Antimaterie hervor, die bei großer Menge und Dichte einen Big Bang verursacht, der alle Formatierungen löscht. Aus der verbleibenden strahlenden Energie ging anschließend und später durch Supernovae die Materie hervor, die wir kennen. Folgen wir weiterhin dem Satz von der Erhaltung der Energie, ergeben sich die Gegenstände der Kosmologie fast von selbst.

EP 9.5 Do 16:30 Foyer Nordbau

Unveiling cosmic voids in large-scale structure surveys: the impact of tracer bias — •Giorgia Pollina — University-Observatory Munich, Germany

The large-scale structure of the Universe can only be observed directly via luminous tracers of the underlying matter density field. However, luminous tracers, such as galaxies, do not precisely mirror the clustering statistic of the bulk of the dark matter distribution: their correlation function (or power spectrum) is biased and depends on various properties of the tracers themselves. Although on small scales this bias is an unestablished function of space and time, on very large scales it results in a constant offset in the clustering amplitude, known as linear bias. In this talk we focus on the bias of luminous objects within and around cosmic voids, enormous under-dense regions of the Universe that occupy the vast majority of its volume. As a remarkable result, we find that – within voids – the relation between matter and galaxy density is always linear and determined by a multiplicative constant. Furthermore, the value of this constant decreases with the increase of the size of voids and asymptotes to the linear bias. This result opens to the possibility of using such simple relation in other voids studies, allowing to extend our theoretical understanding of these immensely large under-densities (typically defined as depressions in the matter density field) to voids that are identified using galaxies as tracers of the matter density. Ultimately we test these findings with observations, using the Dark Energy Survey data currently available.

EP 9.6 Do 16:30 Foyer Nordbau

Monte-Carlo modeling of uncertainties in the detection of plumes on Europa with the Hubble Space Telescope — •Stephan Schlegel[1], Joachim Saur[1], and Lorenz Roth[2] — [1]Institute of Geophysics and Meteorology, University of Cologne, Germany — [2]Department of Space and Plasma Physics, KTH Royal Institute of Technology, Sweden

The search for liquid water within different planetary bodies in our solar system is an ongoing subject of many scientific works. In our work we revisit the detection of Europa's plume within Hubble Space Telescope observations by Roth et al. 2014 and provide a new assessment of the errors associated with the detection. For this purpose we consider the different error sources that occur while processing or are inherent to the instrument or the physics of the system. To achieve better insight on the statistical behavior of such observations, Monte Carlo tests for different emission models of Europa as seen from the Hubble Space Telescope were carried out. For this purpose models with plumes were compared to models without plume. Additionally by varying different parameters, contributions of different error sources could be separated and the significance of the properties of the plumes could be analyzed in detail. Therefore, atmospheric emissions, contribution of the surface reflectance as well as inaccuracies in target acquisition were investigated. It could be shown that the significant Lyman alpha anomaly which was present in the observations has a rather high signal to noise ratio of 5.4 and can most likely be attributed to plume activity.

EP 9.7 Do 16:30 Foyer Nordbau

MHD simulation of rotating insulator planets' magnetospheres — •Justus Sagemüller and Joachim Saur — Institut für Geophysik und Meteorologie, Universität zu Köln

Magnetohydrodynamics is a useful approach to model the plasma dynamics around planetary bodies. This description needs to take into account that matter below the surface of rocky or gaseous planets is an insulator. This results in nontrivial boundary conditions because the simulations usually do not solve for the currents directly, but for the magnetic fields.

A solution to this problem has been given in Duling et al. 2014 with a poloidal-toroidal decomposition based on spherical-harmonic expansion. A direct implementation can work well in particular for e.g. Jovian moons, but has limited flexibility due to the need for a spherical-polar grid and large, pre-computed transformation matrices.

We generalise this scheme, aiming to make it applicable to rotating planets with strong, not axis-aligned intrinsic (dynamo) magnetic field – the most extreme example being Neptune – and implement it on a cartesian grid in the Athena++ code.

The essential rotation of the dynamo field is successfully tested for simple dipole examples, with the goal to ultimately apply the description for future models of Neptune's magnetosphere.

EP 9.8 Do 16:30 Foyer Nordbau

Paleomagnetospheric Modelling of the Hermean Magnetosphere — •Daniel Heyner — TU Braunschweig, Braunschweig, Deutschland

Mercury possesses a very weak magnetic field. The surface field strength at the equator is 190 nT which is ca. 160 times weaker than the terrestrial value. Magnetic field measurements from the MESSENGER probe indicate the possibility of a much stronger dipole moment in ancient times, allowing even a field of comparable surface field strength as the terrestrial value. Mercury is also subject to an intense inflow of solar wind plasma due to its proximity to the Sun. This flow is not steady having intrinsic natural variations as well as the variation due to the changing heliocentric distance along the Hermean orbit. It is known that the solar wind dynamic pressure is also exponentially decaying over time. The solar wind plasma flow exerts an inward pressure on the magnetopause, the outermost boundary of the magnetosphere. The internal magnetic field pressure by the planetary dipole acts against the inward solar wind push. Thus, pressure equilibrium defines the spatial scale of the magnetopause. The electric currents in the magnetopause induce a magnetic field acting on the planet, driving e.g. induction currents in the interior and maybe even quench the internal dynamo process. It is demonstrated, how the magnetopsheric spatial scale changes with a time-dependent internal dipole moment and solar wind pressure using a semi-empirical magnetospheric modeling approach. The resultant magnetopause fields acting on the planet are computed and discussed.

EP 9.9 Do 16:30 Foyer Nordbau

Flux rope formation by a confined solar flare preceding a coronal mass ejection — •Bernhard Kliem[1], Jeongwoo Lee[2], Rui Liu[3], Stephen M. White[4], Chang Liu[5], and Satoshi Masuda[6] — [1]Institute of Physics and Astronomy, University of Potsdam, Germany — [2]Kyung Hee Univ., Yongin, Republic of Korea — [3]USTC, Hefei, China — [4]AFRL, Albuquerque, NM, USA — [5]NJIT, Newark, NJ, USA — [6]Nagoya University, Japan

Two categories of onset mechanism for solar eruptions (coronal mass ejections [CMEs], filament or prominence eruptions, and flares) are currently being debated. Ideal MHD mechanisms suggest the instability of a magnetic flux rope, thus, must assume that a flux rope exists at eruption onset. Reconnection mechanisms assume that a (not yet verified) mechanism of self-amplifying magnetic reconnection commences in a sheared magnetic arcade, triggering and driving the eruption and forming a flux rope as a result. Here we analyze an eruption event which strongly indicates that a magnetic flux rope was formed prior to a major CME by a preceding confined flare (i.e. a flare not associated with a CME). We also present evidence that such flux-rope-forming precursor flares often occur prior to CMEs, which lends support to the ideal MHD mechanism for solar eruptions.

EP 9.10 Do 16:30 Foyer Nordbau

Parametric study of torus instability threshold — •Jun Chen[1,2], Bernhard Kliem[2], and Rui Liu[1] — [1]University of of Science and Technology of China, Hefei, China — [2]University of Potsdam, Potsdam, Germany

Utilizing the analytical model of Titov & Demomulin (1999) to set a toroidal current channel in force-free equilibrium, partially submerged under the solar photosphere to model a solar prominence, we studied the threshold of torus instability for a range of different geometries and external toroidal field strengths. Four parameters of the equilibrium have been varied: minor radius and footpoint distance of the current channel, strength of the external toroidal field, and sunspot distance. The sunspot distance determines the height profile of the external poloidal field's decay index, thus, determines the torus-unstable height range. We found that the critical decay index at the torus instability threshold increases (corresponding to a more stable situation) when the strength of the external toroidal field or the radius of the current channel increase. For given apex height, the threshold does not depend significantly on the footpoint distance of the current channel.

EP 9.11 Do 16:30 Foyer Nordbau

FitCoPI: Fitting density and temperature of coronal active region plasma in 3D from single vantage point observations — •Stephan Barra — MPI für Sonnensystemforschung, Göttingen — Ruhr-Universität Bochum, Theoretische Physik IV, Bochum

Since the solar coronal plasma is optically thin, diagnostics of coronal plasma basically have no resolution along the line of sight. So far, this problem can be overcome only either by stereoscopic observations, or by observing the sun repetitively with enough time lag. The former approach has the problem that STEREO data is not generally available. The latter one suffers from poor time resolution, since the sun needs to rotate until the perspective changes significantly.

We present our newly developed FitCoPI code. It implements a novel method of fitting the solar active region corona to single vantage point observations. The method requires a set of simultaneous EUV or X-ray images. The outcome is an 3D approximation of the density and temperature in the corona. The method is tested against a model corona. Using SDO/AIA data, it is further applied to AR 11087, observed on July 15th 2010, for which the results can be tested against independent data from STEREO A/EUVI. In both cases, the results are very satisfying, though some problems remain near the solar surface.

EP 9.12 Do 16:30 Foyer Nordbau

Untersuchung über die Sensitivität von SOHO/EPHIN auf solare Röntgenflares — •Stefan Jensen, Patrick Kühl, Andreas Klassen und Bernd Heber — Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel, Leibnizstraße 11, 24118 Kiel, Germany

Das Electron Proton Helium INstrument (EPHIN) an Bord der Raumsonde SOHO wurde zum Nachweis von Elektronen im Energiebereich von 0.3 - 10 MeV und Protonen und Helium im Energiebereich von 4 - 51 MeV entwickelt. Es hat sich gezeigt, dass die im Instrument genutzten Halbleiterdetektoren sensitiv auf solare Röntgenereignisse sind. Um dieses Ansprechen zu verstehen, haben wir eine mathematische Modellierung mit Hilfe der GEANT 4 Bibliothek des EPHIN Sensors entwickelt und das Ansprechvermögen für harte Röntgenstrahlung berechnet. Die Berechnungen ergeben, dass aufgrund der elektronischen Schwellen und der mit der Energie abfallenden Wechselwirkungsquerschnitte das Instrument im wesentlichen Photonen im Energiebereich von 30 keV bis 60 KeV registriert.

EP 9.13 Do 16:30 Foyer Nordbau

Thermal Atmospheric Neutron Observation System — •Friederike Schattke, Marc Hansen, Patrick Pohland, Lisa Romaneehsen, Jonas Zumkeller, Robert Wimmer-Schweingruber, and Bernd Heber — Christian-Albrechts-Universität zu Kiel, Institut für Experimentelle und Angewandte Physik, Abteilung Extraterrestrische Physik, Deutschland

The Earth is continuously exposed to high energy charged particles from galactic cosmic rays. Due to galactic cosmic rays interacting with atmospheric particles, secondary neutrons are generated. Those are moderated to thermal energies below 0.025 eV through elastic scattering. The main objective of the Thermal Atmospheric Neutron Observation System (TANOS) is to measure the flux of thermal neutrons in the stratosphere. In order to measure these low energy neutrons we make use of the conversion electrons resulting through thermal neutron capture in Gadolinium. Gadolinium is particularly suitable for the experiment due to its high cross section of 49000 barn. In the atmosphere we expect a radiation field consisting of charged and uncharged particles. The flux of secondary particles is the largest at a height of about 20 km, the so called Pfotzer maximum. To characterize this height dependency of the radiation field, TANOS also measures the flux of charged particles. In this talk we are going to present the detector layout and its response function that is simulated with GEANT4.

EP 9.14 Do 16:30 Foyer Nordbau

Atmospheric Simulation with AtRIS for the Thermal Atmospheric Neutron Observation System — •Marc Hansen, Friederike Schattke, Patrick Pohland, Jonas Zumkeller, Lisa Romaneehsen, Bernd Heber, and Robert Wimmer-Schweingruber — Christian- Albrechts- Universität zu Kiel, Institut für Experimentelle und Angewandte Physik, Abteilung Extraterrestrische Physik, Deutschland

The Earth is continuously exposed to high energy charged particles from galactic cosmic rays. Due to galactic cosmic rays interacting with atmospheric particles, secondary neutrons are generated. Those are moderated to thermal energies below 0.025 eV through elastic scattering. In the atmosphere we expect a radiation field consisting of charged and uncharged particles. The flux of secondary particles is largest at a height of about 20 km, the so called Pfotzer maximum. In the course of the development of the Thermal Atmospheric Neutron Observation System (TANOS), we simulated the expected fluxes with the Atmospheric Radiation Interaction Simulator (AtRIS) which is based on GEANT4. AtRIS has been designed to simulate the interaction of radiation with arbitrary (exo)planetary atmospheres. In this talk we are going to present the results of this simulation.

EP 9.15 Do 16:30 Foyer Nordbau

Thermal Atmospheric Neutron Observation System Junior Calibration — •Patrick Pohland, Friederike Schattke, Marc Hansen, Jonas Zumkeller, Lisa Romaneehsen, Robert Wimmer-Schweingruber, and Bernd Heber — Christian-Albrechts- Universität zu Kiel, Institut für Experimentelle und Angewandte Physik, Abteilung Extraterrestrische Physik, Deutschland

The main objective of the Thermal Atmospheric Neutron Observation System (TANOS) is to measure the flux of thermal neutrons in the stratosphere. In order to measure these low energy neutrons we make use of the conversion electrons resulting through thermal neutron capture in gadolinium. Gadolinium is particularly suitable for the experiment due to its high cross section of 49000 barn. An essential part of the project is the calibration of the instrument for which a ^{207}Bi probe was used. In this talk I am going to present the calibration and its results.

EP 9.16 Do 16:30 Foyer Nordbau

Observations of charge sign dependent modulation of galactic cosmic rays during four successive solar cycles — •Bernd Heber, Marlon Koeberle, Patrick Kuehl, and Johannes Marquardt — Christian-Albrechts-Universität, 24118 Kiel, Germany

The intensity of galactic cosmic rays (GCRs) is modulated as they traverse the turbulent magnetic field embedded in the solar wind. These particles are scattered by irregularities in the interplanetary magnetic field and undergo convection and adiabatic deceleration in the expanding solar wind. The large-scale heliospheric magnetic field leads to gradient and curvature drifts leading to charge sign dependent variations. In this contribution we investigate the time period from 1980 to 2017, including two and one solar minima during the $A < 0$ and $A > 0$ solar magnetic epoch as well as four solar magnetic field polarity reversals. Observations are taken from instruments aboard IMP-8, ISEE-3, Ulysses as well as from PAMELA and AMS-02. While the latter two separate between particle and its corresponding anti-particle the instruments utilized in this study before cannot. In order to compare these measurements with each other we utilize here the electron plus positron flux. Since the proton to antiproton ratio is smaller than 10^{-3} the contribution of antiprotons is neglected. The measurements by the Kiel Electron Telescope aboard Ulysses are altered by the variation along the orbit of the spacecraft that needs to be taken into account.

EP 9.17 Do 16:30 Foyer Nordbau

SUPRATHERMAL PROTONS IN THE INNER HELIOSHEATH: A POSSIBLE MECHANISM FOR THE INTERSTELLAR BOUNDARY EXPLORERIBBON — •Adama Sylla and PD Dr. Horst Fichtner — Theoretische Physik IV

The basis for the modelling of so-called energetic neutral atoms (ENAs) observed with the Interstellar Boundary Explorer (IBEX) is the phase-space transport of suprathermal protons in the inner heliosheath. The modelling of all-sky maps of ENA fluxes at different energies will provide insight into the large-scale structure of the outer heliosphere. Numerical solutions of the transport equation of suprathermal pick-up ions (PUIa) will be presented. These solutions allow to compute the production rates along a given line of sight and, in turn, the differential ENA flux from a given direction. This way synthetic all-sky ENA flux maps will be computed for different ENA energies.

EP 9.18 Do 16:30 Foyer Nordbau

The effects of stellar activity on orbiting planets — •ADriana Valio — Center for Radio Astronomy and Astrophysics Mackenzie, Mackenzie Presbyterian University, Sao Paulo, Brazil

Stellar activity manifests itself in the form of surface spots and faculae and also by flares and mass ejections from its atmosphere. When an orbiting planet transits in front of the star and occults one of these features, small signatures are imprinted in the transit light curve. These can be modeled to yield the physical characteristics of spots and faculae, such as size, temperature, location, magnetic field, and lifetime. Monitoring of these signatures on multiple transits yield the stellar rotation and differential rotation, and even magnetic cycles for long enough time series. Flares have also been detected from active stars, the impact of the flaring UV flux on possible living organisms in close orbit planets is also discussed. Mass ejections also affect the planetary atmosphere being responsible for atmospheric erosion.

EP 9.19 Do 16:30 Foyer Nordbau

A Laboratory for Rapid Space Missions — •Martin J. Losekamm, Laura Fabbietti, and Stephan Paul — Technical University of Munich, Garching, Germany

Small satellites have become a versatile and widely used platform for scientific and commercial technology-demonstration missions. In such short-term missions, costs can be substantially reduced through the use of commercial-off-the-shelve components and ride-share launches. For the same reasons, development times are significantly shorter than for larger satellites. Despite strict limitations in size, mass, and available power, the CubeSat standard—the foundation of the most abundant class of small satellites—has enabled numerous scientists around the world to test or operate their instruments in space.

Within the recently approved DFG Cluster of Excellence "ORIGINS", we will establish a laboratory dedicated to the development of small but versatile satellites and other space-based platforms. These could either be used in preparatory missions to demonstrate technologies for larger endeavors or be self-contained experiments in their own right. In this contribution, we present the rationale for establishing the laboratory and the technologies we intend to develop. We also introduce initial and future science missions.

EP 9.20 Do 16:30 Foyer Nordbau

The ORCA detector — •Christian Steigies[1], Juan José Blanco[2], Óscar García-Población[2], José Medina[2], Ignacio García-Tejedor[2], Manuel Prieto[2], Sindulfo Ayuso[2], Raúl Gómez-Herrero[2], Juan Antonio Garzón[3], Almudena Gomis[4], Victor Villasante-Marcos[4], Marcos Seco[3], Anna Morozova[5], Georgy Kornakov[6], Teresa Kurtukian[7], Alberto Blanco[8], Bernd Heber[1], Helena Krüger[9], and Du Toit Strauss[9] — [1]CAU Kiel — [2]University of Alcalá — [3]University of Santiago de Compostela — [4]Instituto Geográfico Nacional — [5]CITEUC-Univ. de Coimbra — [6]TU-Darmstadt — [7]CEN-Bordeaux — [8]LIP-Coimbra — [9]North-West University Potchefstroom

The ORCA (Observatorio de Rayos Cósmicos Antártico) detector consists of three different instruments with a common field of view: NEMO, MITO and TRISTAN. The goal of these instruments is to measure different components of the secondary cosmic rays that are created in the Earth's atmosphere: neutrons, muons, electrons and gamma rays. ORCA is performing a latitude scan of cosmic rays on its way from Spain to Livingston Island in Antarctica, where the instrument will be installed permanently at the Juan Carlos I research station when it arrives there in the summer season of 2018/19. The data measured by ORCA will be made available for research in scientific databases like NMDB.

EP 9.21 Do 16:30 Foyer Nordbau

Statistical properties of material line elements in incompressible MHD turbulence — •Philipp Hess, Oliver Henze, and Wolf-Christian Müller — Technische Universität Berlin, Berlin, Germany

The statistics of infinitesimal material line elements are studied numerically in stationary incompressible magnetohydrodynamic (MHD) turbulence using velocity gradient time series. The velocity gradient data is obtained by tracking Lagrangian particles in a stochastically forced direct numerical simulation (DNS). The deformation of material lines in turbulence is of fundamental interest and practical importance. Vortex lines and magnetic field lines in an inviscid fluid of high conductivity are examples of vector fields that are proportional to material line elements. It is known analytically and shown in hydrodynamic simulations (Girimaji & Pope 1990) that the length of material line elements increases exponentially in time. The stretching rate of line and surface elements are found to be significantly lower in MHD turbulence than in the hydrodynamic case. Moreover the results show that the material lines are primarily aligned along the direction of the magnetic field. Further the role of the magnetic field in material element deformation is investigated by injecting cross and magnetic helicity into the system.

EP 9.22 Do 16:30 Foyer Nordbau

Investigation of topology-driven magnetic reconnection with CWENO finite volume numerics — •Raquel Mäusle[1], Jean-Mathieu Teissier[2], and Wolf-Christian Müller[2] — [1]Freie Universität Berlin, Berlin, Germany — [2]Technische Universität Berlin, Berlin, Germany

Magnetic reconnection is a process that changes the magnetic field topology due to finite electrical resistivity in the field's plasma environment. A possible trigger for the onset of reconnection is a high entanglement of the field lines which can exponentially amplify the influence of small resistive effects [Boozer 2012].

This type of topology-driven reconnection is investigated by finite-volume numerics in order to verify the proposed theory. The plasma is described by the ideal magnetohydrodynamic (MHD) equations, in which resistivity is neglected.

A simple numerical setup is used to study this mechanism with 3D simulations, in which the initially constant magnetic field is driven to high entanglement. A fast transition from a stationary state to a chaotic state is observed, which is characterized by locally enhanced current densities, large separations of neighboring field lines and a change in the mapping of foot points. The consequences of these observations and their relation to reconnection dynamics are discussed.

EP 9.23 Do 16:30 Foyer Nordbau

A linear slit coronagraph combined with a high resolution partailly multiplexed imaging spectrometer — •Adalbert M. Ding[1] and Shadia R. Habbal[2] — [1]Institut für Technische Physik, Berlin, and IOAP, Technische Universität Berlin — [2]Institute for Astronomy, University of Hawaii, USA

A high resolution imaging grating spectrometer has been designed to continuously investigate the solar corona using a small satellite on a sun synchronous orbit. To discriminate against the diffracted and scattered light from the solar disk a coronagraph set-up with 2 rectangular slits placed in sequence, using linear Lyot-type occulter and apertures, is positioned in front of the spectrometer using an off-axis parabolic and a spherical mirror. The second rectangular aperture acts also as the entrance slit for the spectrometer. The spectrometer uses echelle gratings operating in 40th to 50th order. The sensitivity and the resolution of the instrument makes it possible to measure velocities in the range of 20km/s to 2000km/s through Doppler spectroscopy. Using coatings with particularly low reflection coefficients a reduction of the solar stray light of 8 orders of magnitude is possible. Possible geometries and instrument parameters of the satellite's load will be discussed and compared with earlier results from previous solar eclipses.

EP 9.24 Do 16:30 Foyer Nordbau

NO production in the mesosphere and lower thermosphere during a geomagnetic storm in April 2010 — •Miriam Sinnhuber[1] and Stefan Bender[2] — [1]Karlsruhe Institute of Technology, Karlsruhe, Germany — [2]University of Trondheim, Trondheim, Norway

Electrons accelerated in the magnetosphere during geomagnetic storms precipitate into the polar atmosphere above ≈60 km altitude. Energetic electron precipitation is a major source of NO in the high latitude mesosphere and lower thermosphere due to collision reactions leading to excitation, dissociation and ionization of N_2, O_2 and O, and subsequent ion chemistry reactions.

We investigate NO production during one geomagnetic storm in April 2010 combining observations from SCIAMACHY/ENVISAT with results from a global chemistry-climate model extending up into the thermosphere at about 250 km. During and after the storm, both observations and model results show a clear NO enhancement at geomagnetic latitudes roughly related to the radiation belts. However, comparing the model results to observations reveal differences both in the amount and spatial coverage of the NO production. These differences indicate significant problems probably with the representation of electron precipitation in the model.

EP 9.25 Do 16:30 Foyer Nordbau

Exploring Star-Planet Interactions with MHD Simulations — •Fabian Menezes and Adriana Valio — UPM/CRAAM, Sao Paulo, Brazil

Stars can strongly interact with their close-in planets through their magnetic field. The stellar magnetic field is the driver of activity in the star and can trigger energetic flares, coronal mass ejections and ionized wind. These phenomena may have an important impact on the magnetosphere and atmosphere of the orbiting planets. In this project for Foreign Student Program, we will focus on how stellar magnetic fields, their winds and flares impact close-in planets. Also, we will study how the magnetic reconnection between the planet and the star can trigger stellar activity. To accomplish that, we characterize spots (radius, intensity, and position) on the surface of some stars by fitting the small variations in the light curve of a star caused by the occultation of a spot during a planetary transit. Next, we develop stellar magnetic maps using the spots distribution on the stellar surface. From the spot temperatures we can determine its magnetic field intensity using the same relation of sunspots. This magnetic configuration is used as input for the three-dimensional magnetohydrodynamics numerical simulation of the stellar magnetic field. Moreover, the stellar interaction with a magnetized planet is investigated.

EP 10: Astrophysics II: Galaxies and Cosmology

Zeit: Freitag 11:00–12:30 Raum: HS 19

EP 10.1 Fr 11:00 HS 19

The Assembly of Galaxies in Dark Matter Haloes through Cosmic Time — •Benjamin Moster — Emmy Noether Group 'Galaxies and Dark Matter' — Universitäts-Sternwarte, LMU München — Max-Planck-Institut für Astrophysik, Garching

The field of galaxy formation is on the cusp of a tide of new data. To understand these in the context of an evolutionary picture, we need models that interpret the observed trends. Empirical galaxy formation models provide a unique and direct link between galaxies and dark matter haloes, and do not depend on model assumptions on unresolved physics. They are based on a parameterised relation between the properties of a galaxy and the properties of the halo in which it is embedded. I will present the latest generation of empirical models, which follow the formation histories of individual haloes. Focusing on three main pillars, I will then demonstrate how these models can be used. Firstly, they can be applied to make predictions for galaxies at high redshift, which will be useful for the design of future surveys. Secondly, the empirical models can be contrasted with hydrodynamical simulations, and in this way constrain the physical processes that drive galaxy formation. And thirdly, the empirical models can be used with N-body simulations using alternative cosmologies to test how observables such as galaxy clustering change. Finally, I will discuss the future of empirical models and how AI can help us to better understand the connection between the dark and light components of the Universe.

EP 10.2 Fr 11:15 HS 19

Dynamo amplification and magnetic driven outflows in disc galaxies — •Ulrich Steinwandel[1,2,3], Marcus Beck[3], Alexander Arth[2,4], Klaus Dolag[1,2], Benjamin Moster[1,2], and Peter Nielaba[3] — [1]Universitäts-Sternwarte, München — [2]Max Planck Institut für Astropyhsik, Garching — [3]Universität Konstanz — [4]Max Planck Institut für Extraterrestrische Physik, Garching

We carried out high resolution simulations of isolated Milky Way-like galaxies with a realistic circum galactic medium (CGM) to investigate the possibility to drive galactic outflows launched by the magnetic pressure. Our results indicate biconal (highly magnetised) outflows driven by the magnetic pressure that can reduce the mass of the galaxy by 10 per cent at the end of the simulation. Further, we investigate the amplification process of the magnetic field within our simulations. We find strong evidence for three different processes that amplify the magnetic fields in Milky Way-like galaxies. Amplification by adiabatic compression of the field lines, the alpha-omega dynamo (buoyant bubbles and large scale rotation of the disc) and the small scale turbulent dynamo (amplification by supernova induced turbulence). While adiabatic compression is dominating in the centre and the spiral arms over the whole simulation the small-scale turbulent dynamo is acting in the beginning of the simulation mostly in the inter arm regions and the centre. Once the small-scale turbulent dynamo is saturated we observe a transition towards the alpha-omega dynamo at later times leading to a non-linear growth phase of the magnetic field.

EP 10.3 Fr 11:30 HS 19

The galaxy merger rate from Emerge, an empirical model for galaxy formation — •Joseph A. O'Leary[1], Benjamin P. Moster[1,2], and Thorsten Naab[2] — [1]Universitäts-Sternwarte, Ludwig-Maximilians-Universität, München, Germany — [2]Max-Planck Institut für Astrophysik, Garching, Germany

The galaxy-galaxy merger rate is a critical component in constructing a complete picture of galaxy formation and evolution. We explore the galaxy-galaxy major merger rate in the frame work of the empirical model for galaxy formation, Emerge. Here we define the rate, R as the percentage of galaxies that will merge with another similar sized galaxy (mass ratio 1:4) within some time interval. We find that between 2% and 8% of large galaxies ($M_* > 10^{10} M_\odot$) will experience a major merger per Gyr. Generally, our results exhibit an increase in rate with increasing redshift up to $z \approx 1$, followed by a rapid decay at higher redshifts. The rates we determined through our model tend to be lower when compared with other theoretical models. However, we generally find very good agreement with recent observations, although the rates derived from our model tend to be flatter. Finally, we show that merger rates computed from close galaxy pairs, as done for observed rates, over predict the true intrinsic rates by a factor of 3. This discrepancy has direct consequences for the interpretation of observed galaxy merger rates.

EP 10.4 Fr 11:45 HS 19

A quest for Galaxy Clusters and distorted images — •Matteo Maturi[1], Fabio Bellagamba[2,3], Mario Radovich[4], Mauro Roncarelli[2,3], Mauro Sereno[2,3], Lauro Moscardini[2,3,6], Sandro Bardelli[3], Emanuella Puddu[5], Sebastian Stapelberg[1], and Mauricio Carrasco[1] — [1]ZAH/ITA, Philosophenweg 12, Heidelberg, Fermany — [2]Dipartimento di Fisica e Astronomia, Alma Mater Studiorum Universit'a di Bologna, via Gobetti 93/2, I-40129 Bologna, Italy — [3]INAF - Osservatorio di Astrofisica e Scienza dello Spazio di Bologna, via Gobetti 93/3, I-40129 Bologna, Italy — [4]INAF - Osservatorio Astronomico di Padova, vicolo dell'Osservatorio 5, Padova 35122, Italy — [5]INAF - Osservatorio Astronomico di Capodimonte, Salita Moiariello 16, Napoli 80131, Italy — [6]INFN - Sezione di Bologna, Viale Berti Pichat 6/2, I-40127 Bologna, Italy

Galaxy clusters are fundamental probes to investigate the nature of dark matter, the complex phenomena involving their baryonic content and the nature of dark energy. To properly use them as a tool for cosmology, it is now of crucial importance to have large samples and a solid understanding of their observable and physical properties so as to obtain a reliable statistical sample and control over possible biases. Having this in mind, I will discuss how to detect galaxy clusters in optical photometric data sets and how to identify and characterize strong lensing features such as giant arcs in order to gain a deeper understanding of clusters.

Practical applications to the CHFTLens and KiDS-DR3 data will be presented.

Hauptvortrag EP 10.5 Fr 12:00 HS 19

Synthetic radiation simulations as a path to study the relativistic Kelvin-Helmholtz instability in interstellar jets — •Richard Pausch[1,2], Michael Bussmann[1], Axel Huebl[1,2], Ulrich Schramm[1,2], Klaus Steiniger[1], René Widera[1], and Alexander Debus[1] — [1]HZDR — [2]TU Dresden

The relativistic Kelvin-Helmholtz instability (KHI) is expected in shear flow regions of astrophysical plasma jets originating from AGNs and SNR. It generates magnetic fields that influence the jet dynamics significantly.

We present 3D3V particle-in-cell simulations of unprecedented resolution and extent that not only allow studying the plasma dynamics during the KHI but also making quantitative predictions on the emitted radiation. We present a diagnostic method that allows identifying the linear phase of the instability via a polarization anisotropy observable light years away on Earth and to quantify the growth rate of the instability.

A microscopic model, that describes the fundamental origin of the radiation signature, will be covered in detail during the talk. Technical aspects relevant for performing these large-scale simulations with the particle-in-cell code PIConGPU and for making quantitative predictions with synthetic radiation diagnostics, based on Liénard-Wiechert potentials, will be discussed, and observation limits both for interstellar jets and in lab astrophysics experiments will be covered.

EP 11: Astrophysics III: Stellar Astrophysics

Zeit: Freitag 12:30–13:30 Raum: HS 19

EP 11.1 Fr 12:30 HS 19

Membership and rotation of solar- and low-mass stars in the open cluster NGC 3532 — •Dario J. Fritzewski[1], Sydney A. Barnes[1], David J. James[2], and Klaus G. Strassmeier[1] — [1]Leibniz-Institut für Astrophysik Potsdam (AIP), Potsdam, Germany — [2]Harvard-Smithsonian Center for Astrophysics, Cambridge, USA

Stellar rotation periods can be used as an empirical method to determine ages of cool main-sequence stars. By providing coeval (equal-age) populations of the same composition, but varying mass, Galactic open clusters provide an ideal means to construct and test this technique. However, they are often sparse and have incomplete membership lists.

We present the membership for the very populous, 300 Myr-old open cluster NGC 3532 constructed from radial velocity observations and Gaia DR2 proper motions. From photometric time-series observations of the open cluster we determined rotation periods for 200 stars, spanning the range from solar-mass to low-mass stars.

One of the complexities and opportunities in young open clusters is to study a rotational and magnetic transition from fast to slowly rotating stars. The results confirm the rotation-mass-age relation and provide new information about this transition.

EP 11.2 Fr 12:45 HS 19

Force-Free modelling of stellar magnetic fields — •Thomas Wiegelmann[1] and Jörg Büchner[2,1] — [1]MPI für Sonnensystemforschung, Göttingen — [2]Center for Astronomy and Astrophysics, Technical University Berlin

Exo-planets of dwarfs are easy to detect because of their close orbits. For having a habitable zone planets need shielding by a planetary magnetic field. Exo-planetary magnetospheres are shaped and influenced by the magnetic field and wind of their host-star. Therefor it is important to model the large scale structure of stellar magnetic fields, here a fast rotating M-dwarf. The surface magnetic field (intensity and orientation)is measured with Zeeman-Doppler imaging, a tomographic imaging technique. We extrapolate these measurements into stellar coronae with the help of a potential field source surface (PFSS) model and a nonlinear force-free field (NLFFF) model. We find that open field maps and the global magnetic field structure are very different between these models (much more than for solar applications). The investigated dwarfs contain a large amount of free energy which can cause huge flares.

EP 11.3 Fr 13:00 HS 19

Flow patterns and spiral ring structures in the environment of massive stars — •Dieter Nickeler and Michaela Kraus — Astronomical Institute AVCR, Ondrejov, Czech Republic

Observations with modern facilities reveal the presence of structured environments around evolved massive stars (spiral arms, rings, arcs etc.). The dynamics of gas around stars is often modelled by hydrodynamics (HD). Accretion and decretion phenomena, i.e. outflows from stars, are connected with nonlinear flows, today often treated with numerical methods. The classical representation of nonlinear flows has been done already by Euler, Lagrange and Stokes, later by Clebsch and Monge, using vector potentials from which the flow fields can be derived. These potentials, applied to the HD equations, lead to nonlinear Poisson equations, and represent the vortices or the compressibility of the gas. These nonlinear Poisson equations represent an analogy to nonlinear Schroedinger-Eigenvalue or nonlinear diffusion equations, or the equations of nonlinear magnetohydrostatics. Our aim is to extend these equations and involved methods as tools for investigating the circulation and outflow of circumstellar matter around (massive) stars. Preliminary results, as the existence of blow-up solutions and other nonlinear instabilities, are discussed.

EP 11.4 Fr 13:15 HS 19

A new outburst in the Yellow Hypergiant ρ Cas — •Michaela Kraus[1], Indrek Kolka[2], Anna Aret[1,2], and Dieter Horst Nickeler[1] — [1]Astronomical Institute AVCR, Ondrejov, Czech Republic — [2]Tartu Observatory, University of Tartu, Estonia

Yellow hypergiants are evolved massive stars that were suggested to be in post-red supergiant stage. Post-red supergiants that evolve back to the blue, hot side of the Hertzsprung-Russell diagram can intersect a temperature domain in which their atmospheres become unstable against pulsations (the Yellow Void or Yellow Wall), and the stars can experience outbursts with short, but violent mass eruptions. The yellow hypergiant ρ Cas is famous for its historical and recent outbursts, during which the star develops a cool, optically thick wind with a very brief but high mass-loss rate, causing a sudden drop in the light curve. Here we report on a new outburst of ρ Cas which occurred in 2013, accompanied by a temperature decrease of $\sim$3000 K and a brightness drop of 0.6 mag. During the outburst TiO bands appear, together with many low excitation metallic atmospheric lines characteristic for a later spectral type. With this new outburst, it appears that the time interval between individual events decreases, which might indicate that ρ Cas is preparing for a major eruption that could help the star to pass through the Yellow Void.